Technical Review of Regulatory Proposals

Review of Proposed Replacement Capex in AUSGRID's Regulatory Proposal 2014 - 2019

Report to

Australian Energy Regulator

Energy Market Consulting associates

Strata Energy Consulting

October 2014

This report has been prepared to assist the Australian Energy Regulator (AER) with its determination of the appropriate revenues to be applied to the prescribed transmission services of Ausgrid from 1st July 2014 to 30th June 2019. The AER's determination is conducted in accordance with its responsibilities under the National Electricity Rules (NER). This report covers a particular and limited scope as defined by the AER and should not be read as a comprehensive assessment of proposed expenditure that has been conducted making use of all available assessment methods.

This report relies on information provided to EMCa by Ausgrid. EMCa disclaims liability for any errors or omissions, for the validity of information provided to EMCa by other parties, for the use of any information in this report by any party other than the AER and for the use of this report for any purpose other than the intended purpose.

In particular, this report is not intended to be used to support business cases or business investment decisions nor is this report intended to be read as an interpretation of the application of the NER or other legal instruments. EMCa's opinions in this report include considerations of materiality to the requirements of the AER and opinions stated or inferred in this report should be read in relation to this over-arching purpose.

Except where specifically noted, this report was prepared based on information provided by Ausgrid prior to 5th September 2014 and any information provided subsequent to this time may not have been taken into account.

Energy Market Consulting associates
605 / 657 Pacific Highway, St Leonards, NSW 2065
and
F1.2 / 572 Hay St, Perth 6000
AUSTRALIA

Email: contact@emca.com.au
Web: www.emca.com.au

About EMCa

Energy Market Consulting associates (EMCa) is a niche firm, established in 2002 and specialising in the policy, strategy, implementation and operation of energy markets and related access and regulatory arrangements. Its Managing Director, Paul Sell, is an energy economist and previous Partner in Ernst & Young and Vice President of Cap Gemini Ernst & Young (now Capgemini). Paul has advised on the establishment and operation of energy markets and on matters such as electricity network open access, pricing and regulation and forecasts for over 30 years.

About Strata

Strata Energy Consulting Limited specialises in providing services relating to the energy industry and energy utilisation. The Company, which was established in 2003, provides advice to clients through its own resources and through a network of Associate organisations. Strata Energy Consulting has completed work on a wide range of topics for clients in the energy sector both in New Zealand and overseas.

Authorship

Prepared by:	Paul Sell, Bill Heaps, Mark de Laeter and Gavin Forrest
Quality approved by:	Paul Sell
Date saved:	25/11/2014 11:57 PM
Version:	FINAL REPORT

[This page intentionally blank]

Table of Contents

[This page intentionally blank]

Findings

Repex prudency undermined by systemic failings

1. We have identified systemic issues in Ausgrid's activity forecasts that, in our view, have led to its repex need being overstated. Its repex forecast is likely to have overestimation bias due to:

    - a lack of robust options, risk and cost-benefit analysis supporting the timing/volume of activity at both a project and portfolio level, with replacement targets seemingly based subjectively around regulatory period end points;
    - a lack of reliable asset condition and failure data for some asset classes; and
    - the apparent use of multiple risk assessment approaches and tools, the relative coarseness of the risk rating assessments and the subjectivity of the rating assessments, with in-built conservatism evident in key elements of this process.

2. This view is supported by the need perceived by the Networks NSW (NNSW) Board for the large downward adjustment that it applied to the projected expenditure allowances originally prepared by Ausgrid using its repex planning and budgeting approach.

'Top-down' adjustments likely to be insufficient

3. We understand that the NNSW Board decided to reduce Ausgrid's original capital expenditure allowance by 24%. Normally, we would have increased confidence in a capex program that has had a meaningful 'top-down' challenge. However, such adjustments need to be adequately informed if they are to ensure that the resulting work program is prudent. Moreover, it is not clear by what proportion (if any) the repex component of total capex was reduced.

4. Ausgrid believes that the remaining 76% capex allowance is sufficient to meet its objectives and to maintain risk at current levels. This position appears to be primarily based on a high level assessment of the average age of asset classes. However, the fact that a 24% capex reduction could be made without

a material impact on network risk, and without an apparent asset management-based justification for the reduction, is a strong indicator that Ausgrid's forecasting processes have overestimated required repex. In the prior RCP, Ausgrid similarly over-estimated its requirement and spent 44% less on its Replacement and Duty of Care plan than it proposed to the AER. Despite the lower expenditure, Ausgrid's assets continued to perform well.

5. Setting aside the cost estimation biases we have identified (see below), the absence of a risk projection for the new repex profile makes it impossible to conclude whether the reduction was sufficient to render the resultant program prudent and efficient. It would appear that the systemic over-estimation biases in the bottom-up forecast that were built into Ausgrid's prior period Regulatory Proposal have not been addressed.

Approach to risk is overly conservative

6. Ausgrid's investment decision-making relies heavily on risk-based justification. This is a cause for concern as the portfolio level risk assessment tool employed by Ausgrid is high level and Ausgrid uses a variety of project level approaches. In some asset classes, it appears that a subjective approach is used to determine 'unacceptable risks'; in others, a more formal objective approach is used. In addition to this variability, the approaches used indicate a tendency to apply overly conservative risk ratings. This leads to excessive volumes of forecast asset interventions.[1]

7. Ausgrid's conservatism is evidenced by its Operational Risk Matrix. Our view is that this is biased towards overly conservative and risk averse outcomes. Most of the available risk ratings are either "extreme" or "high", providing less meaningful prioritisation between projects and programs.

Questionable basis for activity forecasts

8. Ausgrid's activity forecasts are formed on a bottom-up basis to reflect:

   - quantitative asset data: including age, condition, and failure rates;
   - qualitative engineering knowledge, experience and judgment; and
   - risk assessments.

9. These are typical elements seen in asset management frameworks. However, a lack of robust options, risk and cost-benefit analysis supporting the timing/volume of activity (at both a project and portfolio level) is evident. Replacement targets are often seemingly based subjectively around regulatory period end points.

10. Aspects of Ausgrid's implementation are susceptible to overestimation bias due to issues relating to the maturity, accuracy and reliability of asset condition data. The conservative and seemingly subjective risk analysis used by Ausgrid will tend to bring forward the timing of interventions, increasing activity volumes in the short-term (and potentially also over the long term if the bias is not corrected).

[1] Potentially the NNSW Board review removed some of this bias, but it is unclear if and how it took this aspect into consideration

11. Our conclusion is that Ausgrid is following an asset management approach that is inclined towards good industry practice, but that its application of the approach to the current Regulatory Proposal is biased towards overstating network risk. The effect of this bias is to overestimate the extent of remedial work required and the associated cost. This casts doubt on the prudency of Ausgrid's repex forecast, even after the NNSW Board-enforced reduction.

Cost estimation is biased towards overestimation

12. In addition to the need for a 'top-down' adjustment, we found further evidence that Ausgrid's cost estimates are likely to be biased towards overestimation, leading to unjustified costs to customers:

    - Our review of outturns indicates a systemic bias of actual repex being considerably less than forecast. We have not seen evidence that this bias has been resolved. This indicates inadequate governance over the cost estimation methodology and its application.
    - Its project estimates contain two layers of risk allowance, which appears to be overly conservative. Corporate contingency is applied across portfolios in addition to specific project allowances. If correctly estimated, a base risk allocation alone should provide adequate budgetary envelope.

13. Ausgrid's estimating process allows a contingency for risk to be applied at the final (Gate 3) approval stage to individual projects. We believe this is unnecessarily conservative in a portfolio forecast and recommend that the aggregate contingency amount in Ausgrid's repex portfolio forecast should not be allowed. Whilst Ausgrid claims that it has recognised these shortcomings, we remain unconvinced that the cost estimation approach applied in developing its expenditure forecasts is sufficiently robust. As such, there is an increased likelihood that Ausgrid will prudently incur lower expenditure during the period than it has proposed.

Repex program has material deliverability risk

14. Ausgrid's proposed expenditure allowance is based on future repex programs that differ significantly from historical work, with higher volumes of smaller projects meaning increased brownfields work. The resulting need for differing skill-sets will create deliverability challenges and may lead to inefficiencies. This will compound delivery issues seen in the previous period.

15. We found no evidence that Ausgrid considered these issues adequately. In particular, we would have expected to see a resourcing and delivery strategy that identified the challenges, mitigation strategies and a detailed implementation plan already in place to support the forecast uplift in brownfields activity in 2014/15. Further, we would have expected forecasts to be scoped in line with such a strategy. The lack of a delivery strategy leads to schedule and cost risk, particularly early in the period.

16. We believe the proposed repex programs carry material deliverability risk and that the AER should seek assurances from Ausgrid that the work programs can be achieved.

Conclusions

17. Ausgrid significantly over-estimated its replacement expenditure requirements in the prior RCP. It claims to have achieved significant efficiencies and to now have materially improved its asset management methods. It contends that this is evident in the significant decline in repex over the final two years of the prior RCP. Despite these claimed improvements in operational asset management, Ausgrid has nevertheless forecast increasing repex from recent levels. We have not seen sufficient evidence to clearly show how these claimed efficiencies and improvements were incorporated into its forecasts. We are not convinced that Ausgrid has provided sufficient justification for the extent of repex work proposed.

18. In summary, there are significant flaws in Ausgrid's repex proposal. We consider that its proposed repex allowance overstates the prudent and efficient amount that it will reasonably require.

1 Introduction

1.1 Purpose of this report

19. The purpose of this report is to provide the AER with technical advice on the network replacement expenditure that Ausgrid has proposed as part of its Regulatory Proposal (RP) for the 2015-19 control period. The assessment contained in this report is intended to assist the AER in establishing an appropriate capital expenditure allowance as an input to its Draft Decision on Ausgrid's revenue level.

20. Our assessment is based on a limited scope review in accordance with the terms of reference. It does not take into account all factors or all reasonable methods for determining an expenditure allowance in accordance with the National Electricity Rules (NER). We understand that the AER will establish a capital expenditure allowance for Ausgrid based on assessments undertaken by its own staff and that other advisers are also contributing to this assessment.

1.2 Scope of requested work

21. The AER issued a Scope of Work to EMCa on 17th July 2014 requesting assistance in identifying any systemic issues that may be resulting in forecasting biases in Ausgrid's RP. The requested assistance was to "identify whether Ausgrid's processes, systems, behaviours and/or cultures are leading to any biases in the capex[2] forecasts" and to "identify whether these biases mean that the capex forecast does not meet the capex criteria."

22. The AER noted three areas in which it considered there may be systemic issues:

- Whether Ausgrid's forecast is reasonable and unbiased;
- Whether Ausgrid's costs and work practices are prudent and efficient; and

[2] The scope was subsequently narrowed to a review of replacement capex ("repex") only

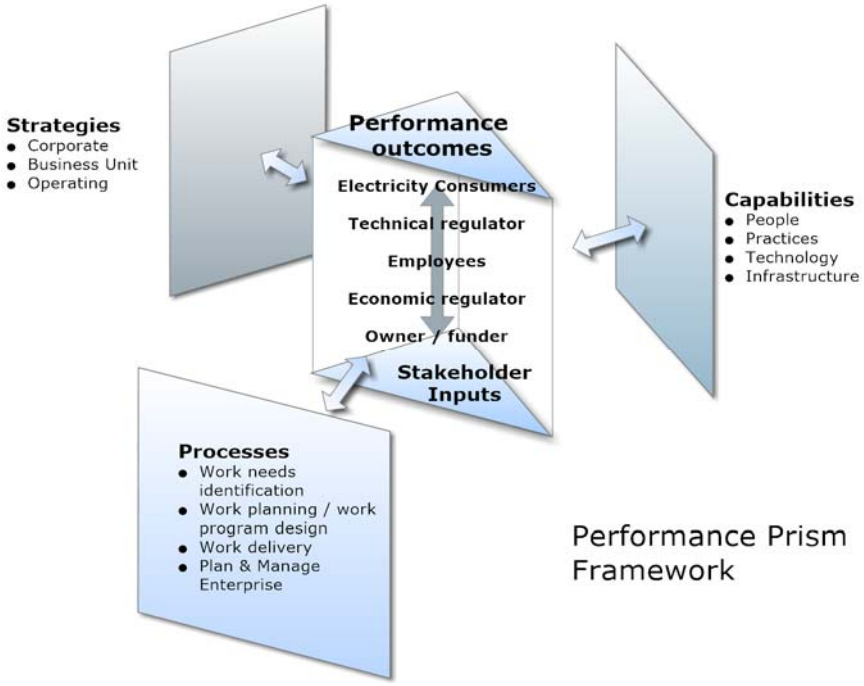
- Whether Ausgrid's risk management is prudent and efficient.

23. The AER asked us to consider a number of more specific matters. These are set out in Appendix A and summarised below.

- Whether the business' forecasts, forecasting practices, and assumptions are reasonable and unbiased.
- Whether differences between historical forecasts and actual expenditures stem from prudent and efficient responses to changes in the business circumstances.
- Are resources, estimates and unit-rates reasonable and unbiased? Is investment timing unbiased and reasonably optimal?
- Are the business' (implicit or explicit) identification, characterisation and evaluation of risk reasonable and unbiased?
- Are risk treatments reasonably optimal in terms of customer costs and benefits?

24. We proposed an approach based on assessing the "performance prism" in which the performance outcomes of the business are determined by its strategies, processes and capabilities, as shown in the following diagram.

Figure 1: Performance Prism Framework



Source: EMCa, adapted from Performance Prism concept[3]

25. The AER asked us to proceed with this work on 30th July 2014. We assessed for systemic issues through a desktop review of: (i) governance and management documentation; (ii) planning, forecasting and budgeting process documentation; (iii) planning and forecasting tools, documentation and input assumptions for each of the material "asset fleet" strategies and plans; and (iv) through an all-day on-site meeting at which Ausgrid executives described

[3] Neely, A.D., Adams, C. and Kennerley, M. (2002), The Performance Prism: The Scorecard for Measuring and Managing Stakeholder Relationships, Financial Times/Prentice Hall, London

their use of this performance framework. To further evidence what the business does, we also reviewed a sample of projects and programs.

26. The assessment in this report is based on the information provided to us through this process.

1.3 Structure of this report

27. Our main findings are summarised at the beginning of this report.

28. In section 2, we provide a context overview of the repex that Ausgrid has proposed along with the hypotheses and focus issues that the AER asked us to assess. This overview includes consideration of past repex trends and Ausgrid's past forecasting performance

29. In the subsequent three sections, we present the assessment that supports our findings. We have structured this as follows:

- In section 3, we describe our assessment of the governance and management processes that Ausgrid uses to plan and approve its repex projects and programs, together with any systemic issues that we identified with these processes;
- In section 4, we describe our assessment of the methods, tools and assumptions that Ausgrid used to determine its proposed repex forecast, together with any systemic issues that we identified with this forecasting process;
- In section 5, we consider Ausgrid's proposed repex by asset fleet and describe any issues that we identified with the proposed expenditure programs. These issues tend to result from systemic issues with Ausgrid's: (1) program and project governance and management; (2) expenditure forecasting processes; and (3) application of these processes and/or use of the relevant tools and input assumptions.

2 Background

2.1 Introduction

30. This section provides background context to the assessments which follow. We first set out the repex allowance that Ausgrid has proposed, in the context of its total proposed capex and relative to its historical repex.

31. We next summarise the focus issues and hypotheses that the AER has already developed from its initial focus assessment and from its top-down assessments of proposed repex, using other techniques.

32. Finally, we consider Ausgrid's repex forecasting performance as evidenced from variance analysis comparing its historical repex with the repex that it claimed to require at the previous revenue reset, coupled with any explanations that Ausgrid has provided for those variances.

2.2 Summary of Ausgrid's proposed repex

33. From information provided in its Regulatory Information Notice (RIN) documentation, Ausgrid is proposing $3,107m[4] of total direct replacement expenditure in the forthcoming regulatory period. Refer to Table 1 below. This equates to average annual forecast expenditure of $621m, compared to an average annual spend of $646m in the prior period.

34. This amount excludes capitalised overheads which are applied at a project and program level as "indirect costs". The apportionment of indirect costs to repex has not been provided. The RIN also shows a "balancing item" in its listing of total capex for which there is insufficient information to ascertain whether, or to what extent, this relates to repex.

35. Our scope of work is to provide technical advice on the proposed programs and expenditure levels for repex only. Accordingly, we did not seek to

[4] Ausgrid RIN data.

reconcile the overall capex information provided by Ausgrid. For the purposes of this report, we used RIN data to establish the relative magnitude of proposed project and program expenditure trends. The RIN data was the only available source of disaggregated historical and forecast repex time series information. Refer to Tables 1 and 3 below.

Table 1: Proposed capex in Ausgrid's RIN – "Replacement expenditure'

RIN - ($m) real June 2014

Expenditure category	2014/15	2015/16	2016/17	2017/18	2018/19	Total
Replacement expenditure	691	704	611	574	527	**3,107**
Connections	28	32	36	35	33	**165**
Augmentation Expenditure	122	91	85	91	100	**490**
Non-network	113	137	131	115	79	**575**
Capitalised network overheads	146	142	124	118	109	**639**
Capitalised corporate overheads	21	20	18	17	15	**91**
Balancing item	-21	-38	-29	-29	-5	**-122**
TOTAL GROSS CAPEX (includes capcons)	**1,100**	**1,089**	**975**	**921**	**858**	**4,943**
Capital contributions	89	61	64	61	61	**336**
TOTAL GROSS CAPEX (excludes capcons)	**1,011**	**1,028**	**911**	**860**	**797**	**4,607**

Source: Ausgrid RIN data

36. In its RP, Ausgrid presents capex in the format shown in Table 2 below. The line item for repex combines "Replacement plans" of $1,431m with "Duty of Care" plans of $345m for a total of $1,776m. (This reflects a 34% increase over the $1,328m spent in the same category in the prior RCP.) We have also established that there is an additional $1,331m of replacement expenditure bundled within the $1,583m total for "Area Plans". Taken together, total proposed repex in the RP sums to $3,107m, which matches the RIN value shown in Table 1. However, it appears that Ausgrid does not clearly identify the repex component of its Area Plan expenditure in its BAU budgeting processes and has not done so overtly in the RP.

Table 2: Proposed capex in Ausgrid's RP – "Area Plans" & "Replacement and Duty of Care plans"

Proposal ($m) real 2013/14

Expenditure category	2014/15	2015/16	2016/17	2017/18	2018/19	Total
Area plans (including system property)	485	428	268	226	176	**1,583**
Replacement and duty of care plans	313	334	365	373	390	**1,776**
Distribution capacity plans	111	111	122	129	125	**598**
Reliability investment plan	6	6	6	6	6	**28**
Technology plan	38	33	36	39	36	**182**
Corporate property plan	41	61	45	25	2	**173**
Fleet and other capex plan	18	12	15	17	18	**81**
TOTAL	**1,012**	**985**	**857**	**814**	**754**	**4,421**

Source: Ausgrid Revenue Proposal, table 23, page 43.

37. In the absence of clear identification of repex in its RP, we necessarily fall back on the RIN repex allowances that Ausgrid has presented as the most serviceable presentation of its actual and proposed repex. We have assumed that the RIN data contains all direct costs for replacement programs as required by the AER. This assumption is further complicated by the different RIN values shown for repex. Table 1 shows total proposed repex of $3,107m whereas Table 3 (with disaggregated data by asset group) shows total proposed repex of $3,280m. We consider that Ausgrid's lack of an orderly presentation of its repex program in its Regulatory Proposal, coupled with its

disjointed identification of repex in its BAU budgets and RIN submissions, is a contributing factor to the poor governance of repex forecasting as identified in this report.

38. Table 3 below and associated graph (Figure 2) show Ausgrid's proposed repex by asset group relative to actual expenditure in the prior RCP. The major expenditure items, and major changes in the mix of expenditure, can be clearly seen in this data. In section 5, we return to consider the implications of our assessment of systemic and asset fleet-specific issues for the dominant asset groups (i.e., according to proposed expenditure level).

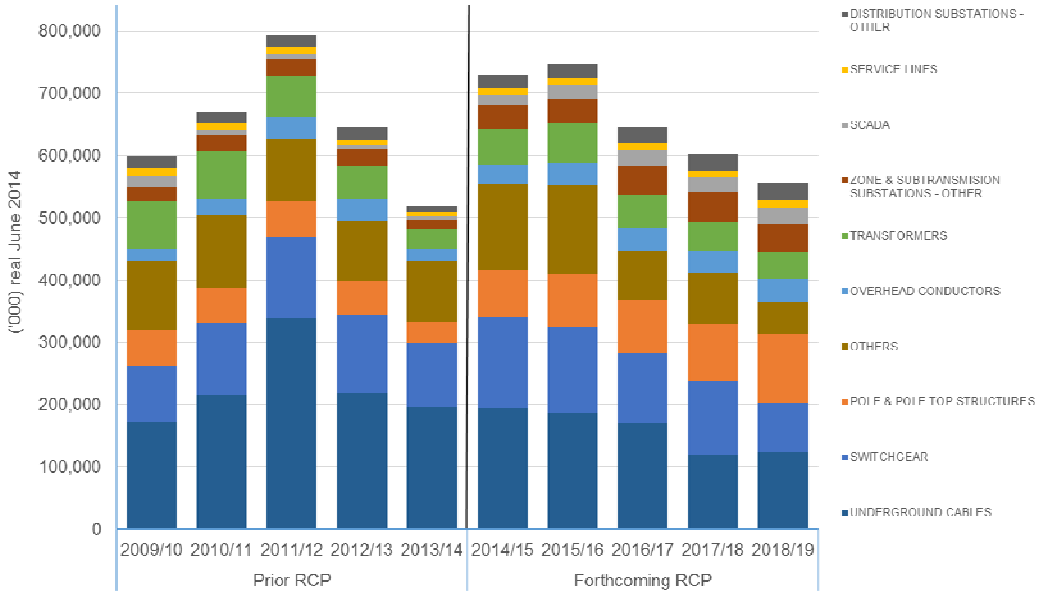
Table 3: Proposed repex by asset group compared with prior RCP expenditure

	Prior RCP	Forthcoming RCP					
ASSET GROUP	Total	2014/15	2015/16	2016/17	2017/18	2018/19	Total	% ±
OVERHEAD CONDUCTORS	**132,852**	31,503	34,675	36,610	35,304	36,496	**174,587**	**31%**
POLE & POLE TOP STRUCTURES	**261,467**	74,905	84,699	84,604	92,130	110,263	**446,601**	**71%**
SCADA	**46,295**	14,965	23,552	25,942	23,591	26,348	**114,398**	**147%**
SERVICE LINES	**50,065**	11,636	11,648	11,401	11,699	12,001	**58,386**	**17%**
SWITCHGEAR	**565,989**	146,117	137,647	111,807	118,785	78,518	**592,874**	**5%**
TRANSFORMERS	**305,484**	57,573	65,233	53,150	46,681	44,326	**266,962**	**-13%**
UNDERGROUND CABLES	**1,138,280**	194,414	187,158	170,318	118,781	123,565	**794,236**	**-30%**
ZONE & SUBTRANSMISION SUBSTATIONS - OTHER	**119,118**	39,685	37,253	45,489	47,353	44,724	**214,504**	**80%**
DISTRIBUTION SUBSTATIONS - OTHER	**87,026**	19,900	22,923	25,300	26,589	26,277	**120,988**	**39%**
OTHERS	**521,253**	138,327	143,018	80,519	82,074	52,145	**496,082**	**-5%**
TOTAL	**3,227,829**	729,025	747,805	645,139	602,986	554,663	**3,279,618**	**2%**

Source: Ausgrid RIN

39. Ausgrid's proposed total repex of $3,280m for the forthcoming period reflects a 2% increase over its actual total repex of $3,228m during the previous period. The most significant asset group investment is for underground cable replacements (i.e., $0.8 billion in the forthcoming RCP compared to $1.1 billion in the prior RCP). However, absent cable replacement, total repex across all other expenditure categories is forecast to increase by 19%.

Figure 2: Repex comparison by asset group – 10 year trend



Source: Ausgrid RIN

40. Ausgrid provides a summary of the outcomes from its prior RCP replacement and duty of care investments in terms of both the type and volume of work completed and stabilisation of failure rates[5].

2.3 Assessment of historical repex

41. Ausgrid's total capex spend in the prior RCP was around $2.9 billion (30%) less than the total regulatory allowance provided in setting its tariffs for this period. Ausgrid has ascribed this to three factors:

- Lower demand growth;
- Efficiencies from reform; and
- Delivery issues.

42. Ausgrid spent considerably less on repex than the AER's previous allowance in the prior RCP. Actual spend for the "Replacement and Duty of Care" component of Ausgrid's prior RCP repex was $1,328m, which equates to 44% (over $1 billion) less than the AER's allowance. An unknown amount of repex was also allowed for as a bundled component of Ausgrid's "Area Plans" for the prior RCP. Ausgrid also underspent in this category by 28% (nearly $1.3 billion). Ausgrid asserts that the increase for the forthcoming period is required to address the consequent increase in age and poorer overall condition of assets. This is despite targeted investment in 2009-14 to address the riskiest assets,[6] substantial underspend in the prior RCP and the steady or slightly increasing failure rates evident from the work undertaken in the prior RCP.[7]

43. Ausgrid was, for key programs of work, unable to explain the variation in expenditure profile in its prior RCP (and between this period and the forthcoming RCP) other than to note that the classification of expenditure categories in the RIN differed from its own classification, leading in turn to inconsistent expenditure profiles.

44. Of relevance to the repex program, Ausgrid states that: "… the reductions in capex are substantial in the last 2 years of the period, and this has been fundamentally driven by changes to our capital program as a result of industry reform";[8] and "As part of this reform process, Ausgrid re prioritised its program to respond to actual conditions experienced in the period and the ongoing development of more comprehensive asset condition data. For example, new data systems and prioritisation systems enabled us to better target our replacement program. Our forecast capex for 2015-19 has incorporated the improvements we have made over the period." [9]

45. As can be seen in Figure 2 above, Ausgrid has proposed repex in the forthcoming RCP that annually exceeds its actual expenditure in the last two

[5] After Ausgrid takes into account its higher level of reporting. Ausgrid, Attachment 5.24, p12

[6] Ausgrid, Attachment 5.24, p3

[7] RP, p36

[8] RP, page 33

[9] RP, page 34

years of the prior RCP.[10] In our assessment, we sought evidence that might support Ausgrid's contention that its proposed repex allowance for the forthcoming RCP does reflect the condition-based prioritisation efficiencies asserted in the quotation above. Noting the significant underspend relative to the prior period's allowance, we also sought evidence that might satisfy us that Ausgrid's forecast is more likely to reflect its actual expenditure than was the case in the prior RCP and that delivery issues have been properly taken into account.

2.4 AER's initial focus issues and hypotheses

46. In its preliminary assessment, the AER noted that Ausgrid's replacement expenditure appeared to be increasing, that the weighted average remaining life of Ausgrid's assets appeared to be high relative to other DNSPs, and that the expenditure justifications provided did not seem to be consistent with good industry practice.

47. We found that, while the information presented in Ausgrid's RP seems to show increasing repex, this is because in its RP only part of its proposed repex is visible with the remainder being a major component of the Area Plans. On examination of the RIN data, it would appear that a better characterisation is that Ausgrid's repex is essentially flat, with the proposed allowance being similar to actual repex in the prior RCP. Nevertheless, we have investigated the proposed repex since, at over $3 billion, it is a large amount that requires sound justification and because within the flat profile overall, there are still significant expenditure variations. For example, as noted previously, Ausgrid's proposal represents a 19% increase in total repex absent cable replacement.

[10] In discussions with Ausgrid, some doubt was raised as to whether the 2013/14 actual expenditure data provided to the AER was in fact for a full year. This doubt was not resolved and we understand that it falls within AER's remit of reviewing data provided.

3 Governance and management framework

3.1 Findings

Repex prudency undermined by lack of robust information and analysis

48. Ausgrid uses a conservative operational risk framework and applies the likelihood and consequence findings conservatively. In aggregate, this results in overstating the risk posed by its assets.

49. In some asset categories, Ausgrid has insufficient quality data to make an optimal assessment of particular asset strategies and to justify the volume and timing of activity.

50. Ausgrid has failed to provide comprehensive cost-benefit analysis to support some of its key asset strategies.

'Top-down' adjustments inadequately informed

51. The 24% adjustment (reduction) that we understand was applied by NNSW to Ausgrid's initial forecast capex may be inadequately informed to ensure that Ausgrid's repex program is prudent. Further, it is not clear how (or if) this 24% reduction has been applied to repex in the proposal and to RIN data. It would be fortuitous if an aggregate forecast adjusted in this manner represents a prudent and reasonable amount.

Repex program has unknown deliverability risk

52. Ausgrid's proposed repex programs vary significantly from its historical work, yet it has not prepared a delivery strategy or a detailed implementation plan. Ausgrid was substantially underspent in the prior RCP due, in part, to delivery issues. The large increase in repex work in the current RCP requires careful

planning due to the different skill sets, safety and access issues typically associated with brownfields work.

3.2 Overview

53. The NNSW Board is supported by the Investment Steering Committee (ISC), which reports to the NNSW Board, which in turn is supported by the Network Steering Committee (NSC) and an Investment Evaluation Unit. Ausgrid is represented on the NSC. Collectively, this reflects a typical investment governance framework. Our major concerns with this framework are not with its structure itself, but rather with the information presented to the various Committees and Ausgrid's conservative risk appetite.

54. We understand that Ausgrid formed its view of the expenditure required to respond to its three expenditure objectives (as set out below) while being cognisant of historical deferred repex:

- Continuously improving safety performance with respect to our customers, staff and the public;
- Maintaining the reliability and sustainability of the network;
- Containing average network tariff increases to CPI for our customers.[11]

55. Ausgrid's governance approach comprises the most typical elements found in good industry practice - it includes an asset management framework[12], investment decision polices and standards[13] and design, operations, and maintenance standards. Its objectives of *safety, reliability and sustainability* are typical electricity network management objectives and are appropriate. However, despite having these elements, we found material issues with the implementation of the portfolio management, asset management and risk management frameworks, as well as delivery planning.

56. While Ausgrid's objective of containing network tariff increases to CPI could be construed as a cost forecasting discipline, this objective is not within the remit of the NER which, more appropriately, supports the determination of tariffs based on prudent and efficient expenditure allowances. In other words, the process is not driven in the opposite direction. It may be the case, for example, that forecasting expenditure levels to "contain average network tariff increases to CPI" results in an excessive network expenditure forecast and that a prudent and efficient expenditure forecast would allow network tariffs to be reduced.

11 Ausgrid, Attachment 5.09, noting that in some Ausgrid documents four objectives are enunciated

12 Ausgrid, Attachment 5.09, Figure 3

13 Policies: Network Investment and Network Reliability; Standards: Area, Replacement, Distribution, Low Voltage and a series of Reliability Planning standards

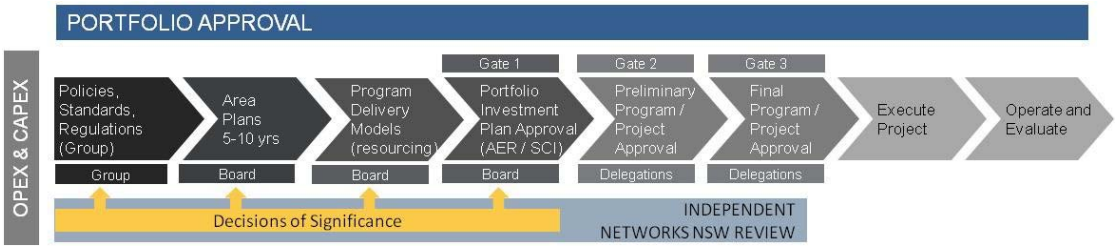
57.

3.3 Assessment

3.3.1 Portfolio approval and risk management

58. Although we have identified at least three versions of Ausgrid's approval process in various documents, we understand that for this regulatory proposal, Ausgrid has applied the approach shown in Figure 3 (as required by NNSW). It provides the NNSW Board a hold-point at Gate 1 for reviewing and adjusting, as necessary, the whole-of-business portfolio of work and subsequent hold points for project/program level investment review and approval.

Figure 3: Ausgrid's Network Governance Investment Framework



Source: Ausgrid, ID06707 Network Investment Governance Framework

59. We understand that Ausgrid applied the CASH/PIP[14] methodology as a decision support tool for portfolio selection. CASH/PIP assigns a risk score to projects from weighting scores derived from answers to high level, subjective questions.

60. We would expect that in addition to using the CASH/PIP approach, the Ausgrid management team, in assembling its original repex sub-portfolio (and in revising it after the Board's cut to its expenditure), would need to have reviewed:

- the investment strategies, volume, cost and benefit assumptions and conclusions for at least the major repex projects (based on the best available information);[15]
- justifications for material step changes in repex;
- the expected impact of the repex program on the state of the network and its performance;
- sensitivity analyses that help demonstrate that increased or reduced repex would be sub-optimal in achieving Ausgrid's business objectives; and
- the delivery strategy and plan.

[14] CASH = Capital Allocation Selection Hierarchy; PIP = Portfolio Investment Prioritisation

[15] Acknowledging that at this stage of the project development lifecycle, there would be a relatively low percentage of projects with business cases – the ACAPS appear to be the best available source of information within Ausgrid (based on the limited additional information provided to us in response to our Information Request)

61. We have not seen evidence of this process at the portfolio level within Ausgrid (i.e., in addition to the CASH/PIP process).

62. Gates 2 and 3 of the Network Investment Governance Framework process are directed at individual projects and programs of work. The description of the activities and responsibilities for Gates 2 and 3 align with common industry practice.

63. As discussed in more detail in Sections 4 and 5, from the information provided by Ausgrid, we found that actual expenditure is often considerably less than forecast expenditure. This is indicative of systemic overestimating bias in Ausgrid's cost forecasting methodology. Whilst Ausgrid claims that it has recognised the shortcomings in the previous forecast to ensure a greater level of accuracy in the forthcoming RCP (including a review of unit costs), we remain unconvinced that the forecasting approach is sufficiently robust.

3.3.2 Top-down adjustment

64. We understand that the NNSW Board decided to reduce the overall expenditure forecast originally developed within Ausgrid by 24%.[16] This decision was informed by the CASH/PIP methodology and was in response to the NNSW Board's objective of reducing expenditure, but only to the extent that a prudent risk level would be maintained.[17]

65. The portfolio adjustment imposed by the NNSW Board indicates that whatever 'challenge' process was used within Ausgrid was inadequate, either in terms of the prudency of the repex work proposed (volume and timing) or the cost of the work.

66. Two questions arise from the NNSW Board's 24% capex portfolio reduction:

- Does it result in a reasonable forecast that is prudent and efficient or does further excess proposed expenditure remain?
- Does Ausgrid have a firm understanding of the risk implications of the reduction?

67. Ausgrid believes that the resulting 76% of its original forecast is sufficient to meet its objectives and maintain risk at current levels. The fact that a 24% reduction could be made to forecast expenditure, without a material impact on network risk, suggests that Ausgrid's planning process delivers an overestimated repex forecast. We asked for, but have yet to receive, information on the process it used to revise its portfolio of expenditure to accommodate the reduction.

68. We understand that the NNSW Board applied a "sense check" to the CASH/PIP results by reviewing a number of projects and, based on this sample, it reduced Ausgrid's proposed expenditure.

[16] We were provided with limited information on the NNSW process subsequent to our assessment which informs this report such that a detailed review was not possible. We observe only the reported outcomes of that process in the current report.

[17] *Ibid*

69. We have not seen compelling evidence that: (i) the Board was provided with information of sufficient quality to make a fully informed decision; and/or (ii) Ausgrid has sufficient understanding of its network risk profile and the cost/benefit of its proposed repex activity to ensure that its expenditure is optimised. The extent of the Board's reduction indicates that any information it did receive was not compelling. Moreover, it is not clear what proportion (if any) of the overall capex reduction was applied to the initially-proposed repex.

3.3.3 Risk Appetite

70. As discussed in Section 4, Ausgrid uses a relatively conservative 'operational' risk framework. The result of applying its criteria (for likelihood and consequence) is a bias towards assessing risks as extreme or high. This leads to difficulty for senior managers to discriminate between the multitude of projects/programs in its list and will tend to exaggerate the repex activity forecast as being required in the next RCP.

71. The calculation of risk adjusted cost with probabilistic distributions (based on Weibull curve fitting) following the Capital Program Optimisation Methodology (CPOM) developed for Ausgrid by Evans & Peck shows promise as a means of providing the Ausgrid executive and management with a robust quantitative portfolio management tool. However, we understand that development and application of the approach beyond project level analysis has stalled as the NNSW Board decided to use the CASH/PIP approach. We have reservations about the extent of benefits ascribed to projects arising from the CPOM and the way in which they are applied, but have not analysed the outcomes in detail.

72. Whilst the CASH/PIP methodology is a useful decision support tool, on its own it will not necessarily lead to an optimal investment repex portfolio.

3.3.4 Program Deliverability

73. Ausgrid has only recently restructured to separate accountability and responsibility for program development and program delivery. It has now established a dedicated Project Management Office (PMO) to provide greater delivery governance.

74. Ausgrid advised that it has not yet developed a Delivery Strategy or Plan for its proposed portfolio of work. However, it appears confident that, because it is delivering approximately a similar volume of work by dollar value as in the current RCP, it will be able to deliver the proposed repex with a combination of its own staff and external service providers.

75. There are significant changes between the work programs undertaken in the previous and current periods. Ausgrid described how it will 'scale-down' its resources in response to reduced augmentation and 'scale-up' its capabilities to deliver the major substation replacement projects. Going forward, the higher volumes of smaller replacement projects indicates a large increase in brownfields work.

76. The changes in the focus of work and the transition of skill-sets to meet different work will create deliverability challenges. The shift from greenfields to

brownfields work will inevitably change the level and nature of outsourced work. These changes may place pressure on the internal resources.

77. We have not found evidence that Ausgrid has considered these issues sufficiently or taken them into account when considering the deliverability of its proposed repex. In particular, we would have expected to see a resourcing and delivery strategy that identified the challenges and set the strategies for their mitigation. In the absence of such a strategy, it is likely that Ausgrid will operate in a reactive rather than proactive manner, leading to inefficiencies in delivering the planned repex program, particularly early in the regulatory period.

78. We contrast Ausgrid's position and information with Endeavour Energy. Endeavour has a fully developed Delivery Plan for the forthcoming RCP and advised that, during the course of its prior RCP, it was able to reduce the cost of internal resources by 30% by leveraging off its experience with use of external resources.[18]

[18] Verbal advice from General Manager Network Development, Endeavour Energy at site meeting, 25 August 2014

4 Forecasting methods

4.1 Findings

Approach to risk is overly conservative

79. Ausgrid's risk-based repex justifications are a cause for concern, due to its tendency to use overly conservative risk criteria.

Questionable basis for activity forecasts

80. Ausgrid use a forecasting approach based on good industry practice, but at the program/project level, we find that there is:

- Inadequate justification of the timing for resolving the condition-based issues (and therefore the volume of activity in the current RCP);
- Inadequate explanation of the degree of step-change evident in expenditure proposed at the sub-category level;
- Lack of robust delivery risk management.

Cost estimation is biased towards overestimation

81. In addition to the need for a 'top-down' adjustment, we found further evidence that Ausgrid's cost estimates are likely to be biased towards overestimation.

4.2 Replacement activity forecasting

4.2.1 Overview

82. Ausgrid uses a generic asset management framework to guide its repex decision making. Of particular relevance are its Network Investment Policy and Replacement Planning Standard.

83. Ausgrid utilises a range of tools and data sources when developing its replacement activity forecasts. These include Failure Mode Effect and

Criticality Analysis (FMECA) and Reliability-Centred Maintenance (RCM), age profiles, asset failure data and risk assessment tools. Ausgrid's investment decision-making relies heavily on risk-based justification.

84. Ausgrid's forecasting analysis leads to repex programs by asset fleet (such as transformers) and individual projects (such as whole substation replacements). These programs and projects are primarily described in a series of Asset Condition and Planning Summary (ACAPS) documents. These documents include asset information, maintenance strategy, risk assessment, options analysis and proposed asset interventions.

4.2.2 Forecasting approach

85. Ausgrid states that: "While we have made strong inroads into removing degraded assets on the network in the 2014-19 period, it has been insufficient to arrest the deterioration of assets as a result of the continued ageing of the network. This has led to an increase of our proposed replacement over the 2014-19 period compared to the current period".[19] It seeks to support this claim with information on the age and condition of the network. However, the justification for increased repex is undermined by a number of inconsistencies and contradictions in its rationale, as described below:

- Ausgrid's primary repex drivers vary across asset categories. If asset condition and failure rate data is immature and/or unreliable, then Ausgrid's basis for replacement tends to default to age;
- Ausgrid contradicts its view on increasing risks resulting from increasing asset age by asserting that average age is a poor indicator of asset health, pointing to failure statistics as more appropriate;
- Ausgrid provides information from 2009-2013 that shows a decrease in mean asset age for distribution substations, poles and towers. Given the low repex in that period (as a result of deferrals and underspend), this information tends to contradict, rather than support, claims about a rapid decline in asset health without increased investment;
- Ausgrid has pointed to its successful strategy of replacing only the highest risk assets (which required much less expenditure in the current RCP than originally proposed) as a means of maintaining overall risk, but now indicates the need for rapid escalation of expenditure because of the risk of deteriorating asset condition; and
- Ausgrid's network performance is satisfactory as measured across a number of metrics (e.g., reliability, fire starts, wood pole failures) and yet in some asset classes even more aggressive performance is being targeted (e.g., wood poles).

86. This often inconsistent rationale reduces confidence in the proposed repex plan.

4.2.3 Risk Assessments

87. Businesses typically use a risk assessment framework based on the ISO 31000 standard. Usually, company Boards treat extreme or high risks as

[19] Ausgrid RP, p34

intolerable with the objective to mitigate them to be "As Low As Reasonably Practicable" (ALARP). Based on Ausgrid's Replacement Planning Standard and Risk Management Plan, this is the approach it follows.

88. According to its Planning Standard: INV-STD-10035, Ausgrid uses an Operational Risk Matrix (see Figure 4 below) as the basis for its risk assessments.

89. This matrix and the accompanying assessment criteria are relatively risk averse – almost two thirds of conditions in the matrix are extreme or high. This is more conservative than approaches in other utilities and is far more conservative than its Corporate Risk Framework. This is further exacerbated by consequence definitions that tend to promote higher ratings and likelihood scales that are very broad.

Figure 4: Operational Risk Matrix

Likelihood		Consequences				
		1	2	3	4	5
		Insignificant	Minor	Moderate	Major	Catastrophic
A	Almost Certain	A1	A2	A3	A4	A5
B	Likely	B1	B2	B3	B4	B5
C	Possible	C1	C2	C3	C4	C5
D	Unlikely	D1	D2	D3	D4	D5
E	Rare	E1	E2	E3	E4	E5

Source: Planning Standard: INV-STD-10035 Asset Replacement and Network Risk, page 9

90. However, in the ACAPS and other documentation we reviewed, we did not see this framework applied in every case. Where it was not used, the risk assessments were more subjective and relied on 'engineering judgement' to assess the acceptability (or otherwise) of the risk posed by assets. Statements such as declaring risks as 'unacceptable' were not supported by adherence to any particular framework.

91. Where the framework shown in Figure 4 is applied, the results are skewed towards high and extreme risk assessments, which by definition need prompt attention. We have observed Ausgrid using these results in two ways: (i) to underpin the recommended replacement strategy work at an asset level; and (ii) as a comparative tool to help determine priorities within asset sub-classes.

92. This does not necessarily mean that the repex program/project is not required, however, it does lead to a bias towards over estimating activity volumes.

4.2.4 Asset Condition and Planning Summaries

93. To gain insight into Ausgrid's asset management methodologies, we reviewed a sample of ACAPS documents. We generally found them to provide a good overview of Ausgrid's approach. We also found that the analyses identified and prioritised the assets classes and sub-classes that require attention. However, when we reviewed the detail, we typically found insufficient justification for the volume and timing of the proposed activity and, therefore, for the expenditure Ausgrid has proposed in its RCP.

94. As part of its options analysis, Ausgrid typically identifies the costs and benefits associated with the various options. It uses only quantitative benefits

in its analysis,[20] but includes qualitative benefits in its overall decision making process. This is a reasonable approach. The identification and evaluation of multiple investment options (including the cost-benefit of deferral options) is not universally adopted. Whilst some consideration of least cost total asset life cycle practices are discussed in the ACAPS documents, it is not clear to us that this is fully implemented. We also have reservations about the extent of benefits claimed, but have not undertaken a detailed review of its approach pending responses to our Information Requests.

4.3 Cost Estimation

4.3.1 Overview

95. Ausgrid uses two main costing methodologies for repex unit costs:

- bottom-up estimates; and
- historical models.

96. Ausgrid advises that its bottom-up estimates are based on unit cost components that are aggregated according to the scope of work.[21] A number of estimating resources are used (e.g., ATAD software package) to develop these bespoke estimates. Ausgrid claims that historical costs are typically used where past costs were proven to be "efficient" and only as a guide.[22]

97. Ausgrid applies a series of contingency allowances to its estimates. These vary based on the scope of the particular project and additional allowances are often applied at a portfolio level.

4.3.2 Cost estimation performance

98. The Arup report[23] provides high level information on Ausgrid's cost estimating performance in the prior RCP, which is summarised in Table 4 below.

Table 4: Cost estimation performance – 2009-2014 (selected repex programs)

Asset **category**	**Estimation performance**[24]
Distribution pole replacement	-12%
Distribution mains (Consac cables)	+320%
Zone substation jobs	+10%
Subtransmission substation jobs	-19%
Sub-transmission mains	-36%

Source: Arup Report, Section B3, ppB22-B27

[20] Ausgrid does not estimate benefits for every option – it depends on whether or not there is a disproportionate amount of analysis required to determine the expected benefits. This is a reasonable approach

[21] Ausgrid, Attachment 5:15, *Section 4*

[22] *Ibid, Sections 3.2 and 4.3*

[23] Ausgrid Attachment 5.01, Ausgrid Historical Expenditure Review, Arup, 24 May 2014

[24] A negative number represents an over-estimation

99. As noted by Arup, Ausgrid's cost estimation performance in the prior RCP was erratic, delivering specific replacement works at materially lower or higher average cost than forecast. Ausgrid contends that improved asset management systems implemented, when combined with recent experience, will improve the accuracy of repex forecasts.[25] In order to better understand this variance and to assess whether it might persist in the current period, we attempted to derive unit cost trends from the RIN data. However, no meaningful pattern was evident.

Approach used for the current RCP

100. The ACAPS documents state that Ausgrid's repex programs are at an early stage of estimation, corresponding to Gate 1 approval requirements. In high-volume works continued from the previous RCP, we would expect the estimates to have accuracy that is superior to the required ± 40% accuracy.[26] It is not until Gate 3 that works must be estimated with ± 10% accuracy for final project approval. This is not as restrictive as some utilities where final approval to proceed is based on firm estimates.

101. We noted in discussions with Ausgrid that increasing volumes of units to be replaced should allow some discounts to be realised. Ausgrid countered that this would not be the case.

102. We consider that Ausgrid's estimation approach will need to improve as works shift from augex to repex, and from greenfields to brownfields, noting that Endeavour was able to extract significant value from 'lessons learned' from its external service providers (i.e., 30% cost reduction – quoted at the on-site meeting).

103. We also note that NNSW has set a $170M reduction target for procurement costs through to 2016. We have not seen evidence that the pro-rated impact of this has been built into Ausgrid's repex forecasts.

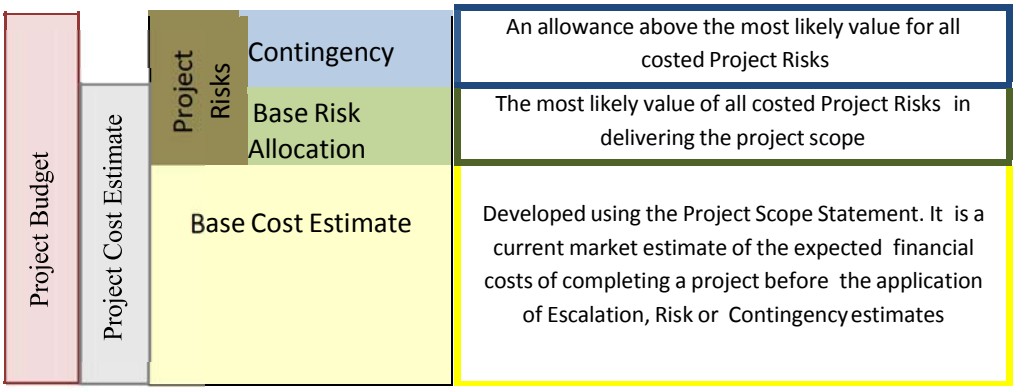
4.3.3 Contingency Allowances

104. Ausgrid's project estimate is comprised of a base cost estimate for the project and an allowance for major risks associated with the project. This reflects the most likely (or expected) cost of the project. Further contingency is then applied across portfolios in addition to specific project allowances.

[25] Ausgrid Attachment 5.01, Section B3.5, pB33

[26] The Economic Appraisal Planning Standard (INV-STD-10024) provides estimate accuracies for the various Gates, which we have relied on

Figure 5: Project budget formulation



Source: Planning Standard INV-STD-10024

105. The above project budget structure is overly conservative if a contingency amount is applied at the portfolio level. If correctly estimated, the *base risk allocation* alone should provide adequate budget at a portfolio level since the aggregate estimate of all project costs should not exhibit a cost bias. If estimates have been developed based on an 'expected' cost, then under and over-spends should (on average) balance out across the portfolio.

106. With its learnings from the prior period and refined estimation models, it is reasonable to expect that Ausgrid should be able to specify sufficient project budget without the added contingency.

107. In summary, based on the over-estimation bias we found in Ausgrid's repex programs and the relative immaturity of estimates, there is likely to be considerable scope for improving its bottom-up estimates.

5 Proposed expenditure programs

5.1 Findings

108. In all but one of our program reviews, we found that Ausgrid had sufficient basis for adopting the proposed focus area (e.g., SCFF cables, 11kV switchgear, wood poles) in its program[27]. However, we identified issues in the majority of the programs we reviewed (as set out below).[28]

- Prudency undermined by:
    - A lack of robust options, risk and cost-benefit analysis in support of the timing/volume of the activity; replacement targets are seemingly based subjectively to coincide with regulatory end points;
    - A lack of reliable asset condition and failure data;
    - A variety of risk assessment approaches, with a bias towards conservatism based on either managerial experience or (when used) an operational risk framework that is biased to give high and extreme results;
    - A lack of consideration of delivery management, noting that delivery constraint was one of three main reasons nominated by Ausgrid in its self-analysis of the 2009-14 RCP underspend;

[27] The exception being its SCADA , Network Control & Protection asset category

[28] We reviewed a number of asset sub-programs and projects for each asset category, as denoted in Appendix B

- Inadequate justification of the step change evident in expenditure from the last two years of the 2009-14 RCP to the 2015-19 RCP and in total repex excluding cable replacements.

- Cost efficiency undermined by:
  - inadequate evidence to show that estimation errors from the previous RCP had been addressed;
  - the lack of business cases for the proposed work[29] - which, if available, would explain the source and assumptions underpinning estimates such as the contingency margin allowed, lessons learned from previous work (where applicable), the sourcing strategy for material and labour (including the rationale for using internal labour vs external service providers) and how Ausgrid's 'share' of the NNSW materials procurement JV had been taken into account;
  - the lack of a delivery strategy – which we would expect to provide compelling evidence that Ausgrid had adequate risk management strategies to ensure, among other things, that it would not be exposed to undue cost increases in the context of a predominately brownfields (and therefore complex) $3b repex program.[30]

109. In summary, our analysis of a sample of repex expenditure programs supports the issues identified from our analysis of Ausgrid's governance and management framework and its forecasting methodology.

5.2 Assessment

110. The main components of proposed repex, and the movements between actual prior RCP expenditure and Ausgrid's proposed expenditure, are outlined in section 2. The following subsections provide summary information on the material components of the proposed repex and which were used to evidence the systemic issues reported in our findings.

5.2.1 Cables

Ausgrid's strategy for cables

111. Ausgrid has adopted a strategic goal for the removal of high-risk sub-transmission cables over the long term, with each cable prioritised for removal based on a revised risk rating.[31] This strategy replaced a largely reactive approach.

112. The driver of Ausgrid's strategy and proposed expenditure is the increasing incidence of faults in self-contained fluid-filled cables (SCFF, oil) and gas-filled

[29] Whilst acknowledging that this is not unusual at this stage in the project development life cycle

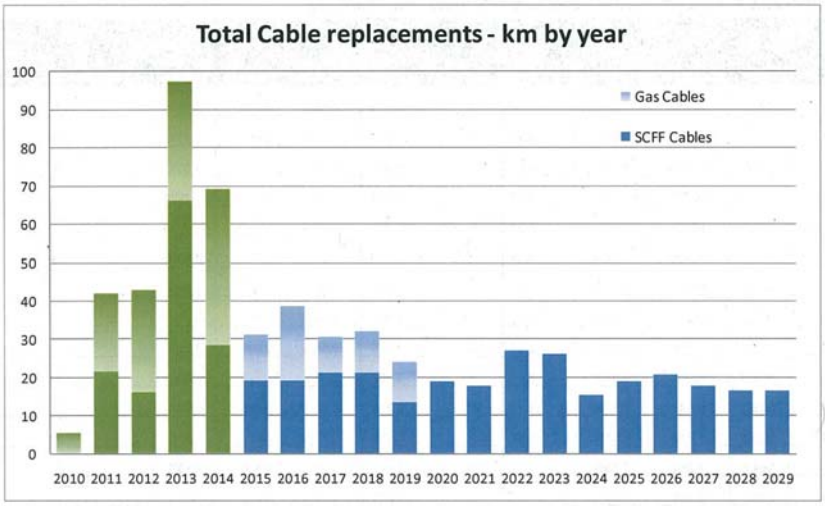
[30] Combining the repex evident in the Area Plans as well as the Replacement & DOC categories

[31] Strategic Asset Prioritisation sub-transmission cables, Rev 02, July 2012

cables and the consequent impact on circuit availability and environmental compliance. The strategy was developed cognisant of: (i) the potential difficulties in accessing specialist cable repair skills; and (ii) a complementary spares strategy.

113. High levels of cable replacement has already occurred within the prior RCP and forecast volumes are reducing. Figure 6 displays the forecast volume of replacements for SCFF (oil) and gas filled cables to 2029.

Figure 6: Total cable replacements (km) for period 2010 - 2029



Source: Figure 28, Strategic Asset Prioritisation Sub-transmission Cables

SCFF cables

114. The initial replacement strategy, formulated in 2008, was to remove all high risk SCFF cables in waterway crossings by 2019, with the entire replacement of SCFF cables by 2024.

115. We understand that this has been further revised and a target date of 2029 for the replacement of remaining SCFF cables by Ausgrid[32] as being:

> *"… more sustainable with expected lower life cycle cost outcomes, at an acceptable risk for the complete replacement of this asset class. The proposed deferral is underpinned by initiatives to improve training, leak detection, electrical testing and maintenance, spares holdings and agreeing a new leak rate reduction target with the Environmental Protection Authority (EPA)." (Ausgrid Executive Report, July 2012)*

116. Ausgrid have sought independent advice from Jacobs SKM who tested the strategy against industry peers, including overseas peers. Limitations on Jacobs SKM's report include:[33]

- '*Jacobs SKM has not reviewed individual replacement projects and investment decisions for prudency and efficiency';* and

[32] Subtransmission cable replacement strategy, Peer review Final Report V2.2, April 2014

[33] *Ibid, p5*

- '*Jacobs SKM was not able to observe how the overall strategic target for the replacement program was set and adjusted, and whether this was undertaken on a risk-based cost-benefit analysis.*'

117. However, Jacobs SKM's analysis includes an observation that 'the strategy will result in the bulk of the SCFF cables being replaced at an age greater than the standard asset life. [34]

Other transmission cables

118. For the high voltage non-SCFF 33kV, 66kV and 132kV cables included in the Transmission Mains asset category, Ausgrid has adopted a strategy that applies a combination of planned and reactive replacements with the use of strategic spares (such as cable repair accessories) to reduce the impact of failures on consumers. Ausgrid is undertaking more detailed analysis of cable failures in order to better predict specific failure types.

Low voltage cables

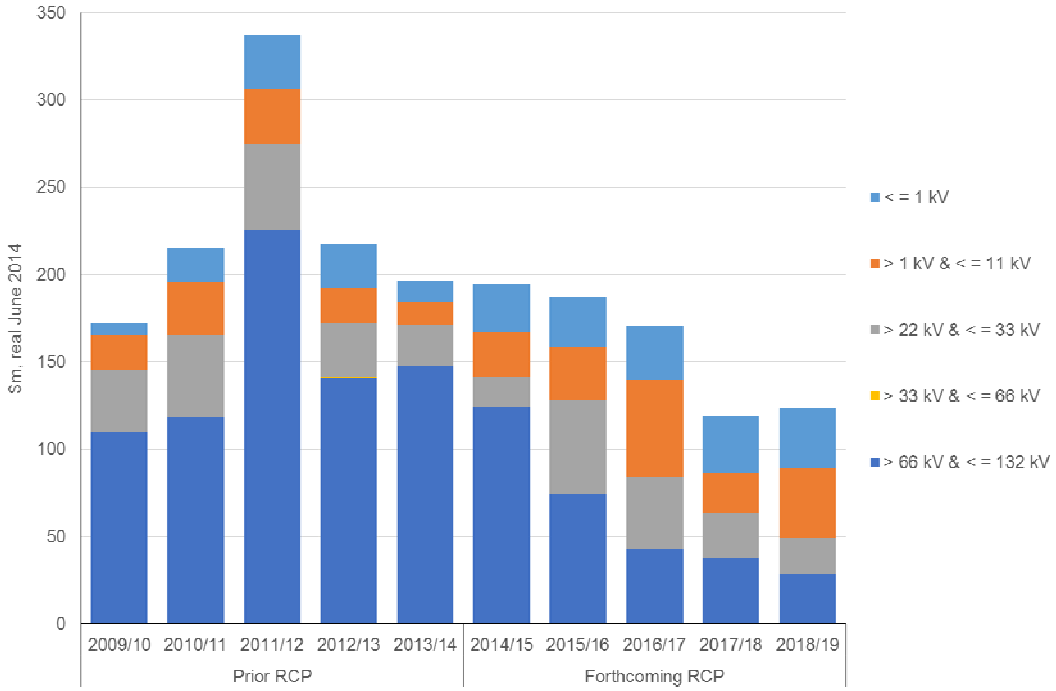
119. For low voltage non-SCFF cables, Ausgrid is addressing aging assets and some legacy issues with particular types of cables (e.g., CONSAC) where failure rates are predicted to increase. It has adopted a planned replacement strategy based on age and predicted condition coupled with a reactive replacement strategy (i.e., when failures occur). We note that for some cable types it has indicated that the proposed level of expenditure may be insufficient to address the projected increase in failures.

Expenditure trends

120. The expenditure profile for cables reflects a change in strategy. In the previous RCP, a core driver was the replacement of transmission mains (primarily 66kV and 132kV). The RIN profile indicates a major shift of investment emphasis from high voltage cables to lower voltage cables in the forthcoming RCP. Refer to Figure 7 below.

[34] *Ibid, p*

Figure 7: Ausgrid cables repex compared with historical spend



Source: Ausgrid RIN data

121. Figure 7 shows substantial investment in HV cables in the 2009-14 RCP. In the forthcoming RCP, the completion and decline of HV expenditure is clearly evident, together with a marked increase in expenditure for lower voltage cables (< 1kV – 22kV).

Alignment of expenditure and strategy

122. Whilst we support the adoption of a strategic approach to the replacement of the identified subtransmission cables, and the comparisons made to some international utilities by Jacobs SKM, we did not observe a detailed assessment of the whole-of-life asset management approach undertaken.

123. In particular, whilst Ausgrid have used the SCFF and gas leakage rates and the environmental compliance factors to explain the need for the progressive replacement of cables, we were not able to observe a risk-based cost-benefit analysis for determining the timing of the work.[35] Risk analysis seemed only to be used for comparative analysis (i.e., to prioritise between the various cable systems and to order the work program.[36] We could not observe the application by Ausgrid of a formal risk framework (such as the NNSW corporate risk matrix or the Ausgrid operational risk framework).

124. We noted that the replacement date of many of the 132kV oil filled cables was presented by Ausgrid as being beyond the standard design life of 45 years.[37] However, we found evidence that the life expectancy of oil-filled cables may be understated and, more significantly, may differ from Ausgrid's own planning documents. Ausgrid's *2013 Sydney Inner Metropolitan Area Plan* makes the

[35] Timelines appear to have been struck with the EPA, but Ausgrid has demonstrated its capacity to negotiate extensions of time based on further analysis and performance

[36] Which is based, appropriately, on the environmental impact and the leakage volume

[37] Strategic Asset Prioritisation Sub-transmission Cables, Figure 24

following comment in relation to TransGrid's treatment of its 330kV oil filled cable (Cable 41) :

> *"It has been assumed that this cable will have a usable life of approximately 50-55 years, which is consistent with Ausgrid's planned approach to cable replacements on the 132kV network."*

125. Ausgrid advised that a process to review the SCFF cable replacement program was undertaken in preparation for the 2015-19 RCP:[38]

> *"The revised condition risk assessment again examined the known condition issues, access issues, potential environmental risks (now including proximity to waterways), failure history and availability of all 33kV, 66kV and 132kV feeder cables to determine an overall risk ranking to prioritise the order in which the cables should be replaced."*

126. The resulting program generated a revised risk ranking of cable replacement resulting in deferral of $185m of capital expenditure during the RCP *within an acceptable level of organisational risk for this asset class*. This was assisted by implementation of other risk mitigation initiatives such as improved training, improved oil leak detection, spares and agreement to a new leak reduction rate with the Environment Protection Authority.

127. We note the revised program will now achieve:

- *the cables which contribute 84% of the total volume of oil leaks are projected to be replaced by 2019, but many are dependent on the repair or replacement strategy for the Transgrid Feeder 41; and*
- *the cables that contributed 64% of the total volume of gas leaks will be replaced by 2014, with all other gas pressure cables targeted for replacement by 2019.*

128. We understand from our review of the documents provided that these reductions followed earlier reductions of $960 million[39] removed from the original forecast as a result of reduction in replacement volumes and efficiency gains following systematic examination of individual cable projects. The total savings were the result of a project timing review, project scope review and engineering standards review.

129. The scale of the reductions achieved in the sub-transmission cables program indicates to us that the initial planning was insufficient and led to imprudent levels of expenditure in the early stages of this program. We have not seen sufficient evidence to demonstrate that this has been fully addressed in the proposed program for the future RCP.

Relationship to Area Plans

130. Ausgrid includes approximately $1.3b of replacement expenditure within its Area Plans. The Area Plan development for the inner Sydney area considers a number of drivers including capacity and condition. Whilst the review of

[38] Strategic Asset Prioritisation Sub-transmission Cables, Addendum

[39] 1419 Regulatory reset – transmission cable replacement programme, Oct 2012

capacity driven expenditure and related inputs is not within the scope of our review, we reviewed the implications for the forecast repex.

131. For example, following the de-rating of a 330kV supply cable (Cable 41) to the Sydney area by TransGrid, Ausgrid advised that:[40]

> *"Some Ausgrid 132kV feeders which form part of the 'Inner Metropolitan' transmission system have also been de-rated as they were originally owned and installed by TransGrid and have the same deteriorated trench backfill material issue as Feeder 41."*

132. Ausgrid further state a number of key risks including the requirement to extend the life of existing assets to meet the planning criteria including 132kV cables which cross Sydney Harbour, previously identified as a priority for replacement.

133. The Area Plan considers a number of options relating to the resultant rating, capacity and replacement timing of its 132kV cable network. Ausgrid state that:[41]

> *"The long term vision agreed between Ausgrid and TransGrid is to progressively augment capacity in the inner metropolitan area at 330kV rather than 132kV (where cost effective), reducing complexity and inter-dependency between the two networks."*

134. We observe that a considerable amount of discussion in the Area Plan is dedicated to understanding options to meet planning requirements, including assumptions of TransGrid's network. The preferred option included a number of projects to augment and upgrade Ausgrid's 132kV cable network and a new 330kV augmentation in the subsequent RCP to respond to the nominated drivers. Whilst a number of projects within the preferred option were nominated as "Condition" related, the separation of other drivers was not clearly evident.

Data integrity

135. Ausgrid have advised that they have taken a prioritisation approach to the high risk cables, within a strategic framework for broader cable management. However, the reasonableness of forecast expenditure is dependent on the accuracy and reliability of cable failure data. Ausgrid acknowledges the need to improve its analysis of cable failure risks.

136. We note that the expenditure forecast in the RIN is quite variable and the reasons for this have not been adequately explained. In discussions with Ausgrid, we were informed that this was likely due to the categorisation of data in the RIN. Again, we consider this to further reduce our confidence in the prudency and efficiency of the proposed repex.

[40] Strategic Asset Prioritisation Sub-transmission Cables

[41] 2013 Sydney Inner Metropolitan Area Plan

5.2.2 Switchgear

Ausgrid's strategy for switchgear

137. Ausgrid's asset strategy and proposed expenditure on switchgear is largely driven by increasing faults, poor condition and obsolescence within its fleet of 11kV switchgear. The strategy describes a strategic replacement plan for its 11kV compound insulated switchboards, air insulated switchboards and outdoor switchgear over multiple regulatory periods extending to 2029.

138. The prioritisation approach nominates switchboards for replacement and for consideration in the development of respective area plans. The approach is based on an assessment of risk from a number of factors including asset condition, ability to recover from a failure, and technology obsolescence. The program has been compared against an age-based replacement option only to demonstrate that it is the lower cost option.

139. We understand from the documentation reviewed that the strategy commenced in 2010, with higher priority items included in the current RCP and expenditure in subsequent periods corresponding to expenditure with decreasing levels of risk. To mitigate the extreme risk rating associated with a number of the compound insulated and air insulated switchboards, replacement of 11kV bulk oil circuit breakers is also included over the period 2010 – 2024, as a means of life extension.

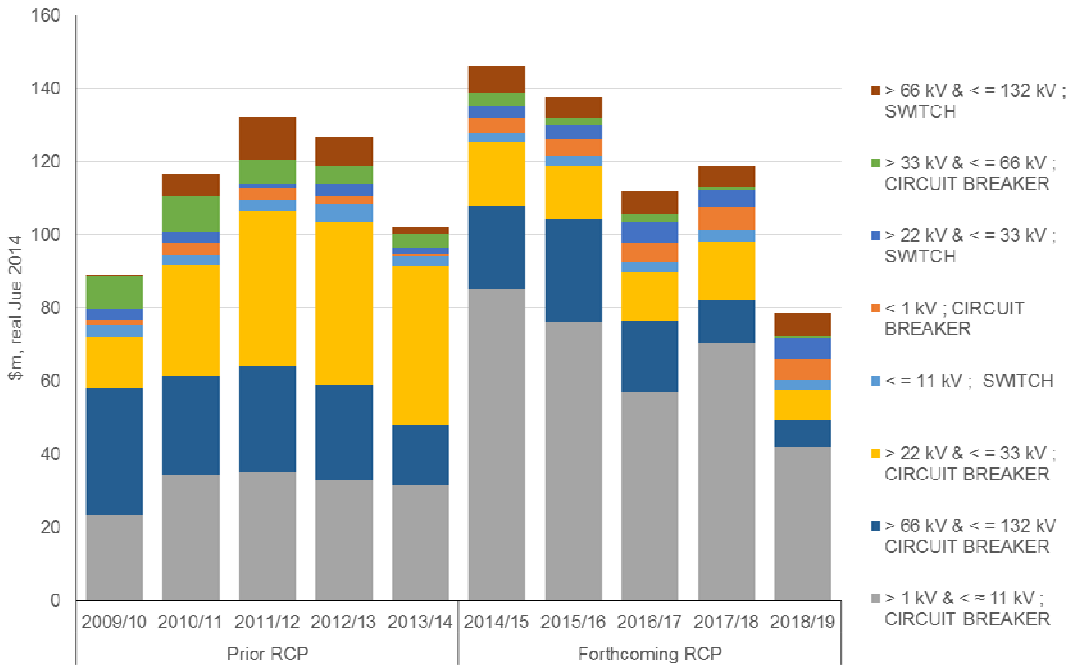
140. Ausgrid commissioned a study of its CBRM approach for switchgear. It found that its management processes have been effective at extending the life of this asset fleet beyond its peers within the study group. Further, Ausgrid provided a review of the replacement program against the average age as a means to demonstrate the timely replacement of this asset fleet.

141. It is not clear how the life extension strategy and replacement strategy have been optimised as part of a total life cycle analysis.

Expenditure trends

142. Expenditure is separated between the asset replacement components of the Area Plans and the ACAPS documents for switchgear. Ausgrid undertakes an integrated planning process within its Area Plans, including consideration of the optimal timing and efficient packaging of delivery options for both augmentation and replacement requirements. A list of priority areas for the switchgear replacement strategy is included in the Area Plans.

Figure 8: Ausgrid switchgear repex compared with historical expenditure



Source: Ausgrid RIN data

143. The shift in strategy from high voltage to lower voltage circuit breaker replacement is confirmed in Figure 8[42]. The step change towards replacement of lower voltage units implies a large increase in the volume of work and is not adequately explained by Ausgrid. As this is labour intensive brownfields work, this will increase the volume and complexity of network and site access issues and related logistical tasks.

144. The expenditure associated with ACAPS2012 shows a declining trend from a peak in the first year of the forecast RCP. The priorities for ACAPS2012 include replacement of switchgear in air insulated switchboards only for the current RCP, and the declining trend may represent the declining priorities of work from the prior RCP.

Alignment of expenditure and strategy

145. Ausgrid has an established program for switchgear replacement. For the larger projects, Ausgrid adopts a bottom-up build of replacement costs. We note that there is no direct expenditure provision for replacement on failure because Ausgrid intends to manage such failures within its total repex budget.[43]

146. Extreme risks and consequences are unlikely to be caused by the types of faults identified by Ausgrid and can generally be addressed through corrective maintenance. ACAPS012 provides the following statement:

> "The failure of an 11kV circuit breaker will result in either the loss of the associated 11kV distribution feeder or will result in the inability of that

[42] The expenditure profile for the ≤11kV CBs does not align with Figure 1 in ACAPS2012

[43] Addendum to ACAPS2012

particular circuit breaker to operate and provide protection against short circuit or overload."

147. Ausgrid's risk assessment[44] is based on application of the operational risk matrix and leads to identification of three extreme risk ratings. It is not clear whether these risk ratings have been based on the residual risk following 11kV CB replacements in 2009-14, but the indicated 2% (one in 50 year) likelihood of loss of load following a breakdown failure[45] suggests that the risk rating of 'extreme' is excessive.

148. Ausgrid only considers one option in addition to 'Do nothing'. The options analysis should consider reasonably plausible options, including the cost-benefit of varying levels of replacement over time and risk mitigation options supported by credible cost-benefit analyses. The absence of robust options analysis combined with the conservative risk assessment supports our view that the program is likely to be suboptimal.

149. Limited information is provided to demonstrate that the cost estimate for the work is efficient.

5.2.3 Poles

Ausgrid's strategy for Poles

150. ACAPS4001 sets out Ausgrid's strategy for pole asset management. Ultimately, the identified need for asset intervention in the fleet is the potential risks arising from pole failure. Ausgrid has calculated pole failure likelihood based on age and knowledge of the condition of all the poles in the network. Remedial work is prioritised based on risk, with discrimination of consequence of failure provided by considering locational factors such as proximity of poles to high population and property densities.

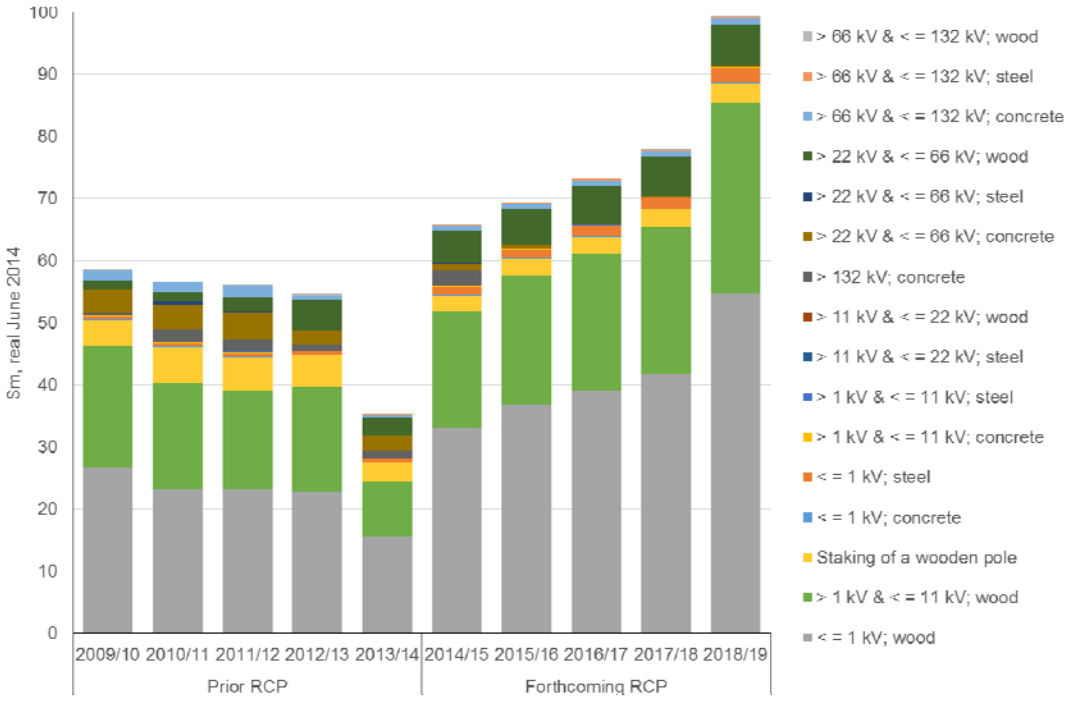
Expenditure trends

151. The repex for poles over the previous and current RCP is depicted in Figure 9 below.

[44] Section 5, ACAPS2012

[45] Table 19, ACAPS2012

Figure 9: Ausgrid pole repex compared with historical spend



Source: Ausgrid RIN data

152. Ausgrid's RIN disclosure statement shows a rapidly increasing replacement of 11kV and LV wooden poles. This is primarily driven by the age profile of the poles supported by failure data.

153. We asked Ausgrid to explain the reason for the low expenditure in 2013/14 and were advised at the onsite meeting that the data was only for part of the year.

Alignment of expenditure and strategy

154. ACAPS4001 indicates that Ausgrid is reinforcing (nailing) its wooden poles to extend life. On average, it claims that 46% of defective poles are being reinforced.

155. We observe that Ausgrid has a current pole failure rate of 0.18 per 10,000 poles per year, well below the industry benchmark and that the failure rate has remained relatively constant for a number of years. Ausgrid state an aspirational target of 0.1 per 10,000 poles however we were not able to observe an economic analysis supporting this. It is unclear how this target has informed the strategy selection.

156. Following options analysis, Ausgrid concluded that continuing the condition based replacement/reinforcement option had the lowest cost and delivered the lowest risk position. We concur with Ausgrid's strategy of reinforcing poles that are assessed as requiring treatment and have sufficient above-ground strength. However, in Figure 9, the proportion of expenditure on reinforcement does not appear to be in the range indicated by Ausgrid (i.e., 40-50% of poles requiring treatment).

157. ACAPS4001 shows a peak in pole replacement expenditure occurring in 2013/14. The RIN does not show this occurring; we assume this is because the data provided to us for that year may be incomplete. If it is shown that

actual expenditure in 2013/14 was below the forecast $70m, serious questions would be raised regarding Ausgrid's capability to deliver its proposed pole program.

158. It is not clear, from the information provided, why Ausgrid's expenditure was forecast to be almost 50% higher in 13/14 than 12/13. More importantly, there is insufficient justification for the forecast 26% increase in expenditure in 2018/19 from 2017/18.[46]

159. Ausgrid applies its operational risk framework and identifies two sources of extreme risk based on catastrophic outcomes (i.e., electrocution and bushfire ignition).[47] If this analysis were based on the NNSW risk framework, these same risks would be assessed as high, not extreme. This is an example of Ausgrid's risk assessment being conservatively biased. Whilst we support the need for remedial action of poles that are assessed as requiring treatment, we remain unconvinced that the acceleration in replacement/reinforcement activity forecast will be required from condition-based assessment in the 2015-19 RCP.

160. Ausgrid has identified and analysed a reasonable number of credible options in ACAPS4001. Whilst we have reservations about the benefits analysis, we believe the analysis presented supports the recommended strategy.

161. Ausgrid refers to an average wood pole replacement unit cost of $10,700 and an average reinforcement unit cost of $830. We did not observe compelling information to demonstrate that these costs are efficient or that Ausgrid has credible strategies identified or in place to improve on these average costs. Our experience is that the replacement cost is high and the reinforcement cost is reasonable.

5.2.4 Transformers

Ausgrid's strategy for transformers

162. Ausgrid have a range of transformers at transmission and distribution voltages. Strategies are set out in a number of substation ACAPS documents. Transformer and substation strategies were discussed at the on-site sessions. Ausgrid advised that the maturity of the condition information that they hold on transformers is good, allowing fully informed asset management decisions to be made.

163. For zone and sub-transmission transformers, Ausgrid has adopted a strategy of holding strategic spares and using these for replacement of transformers that are assessed as being at the end of their life (i.e., corrective failure) or that suffer breakdown failure.

164. For distribution substations, Ausgrid has adopted a planned and reactive replacement approach depending upon type, age and condition. The ACAPS

[46] Table 17, ACAPS4001

[47] Table 12, ACAPS4001

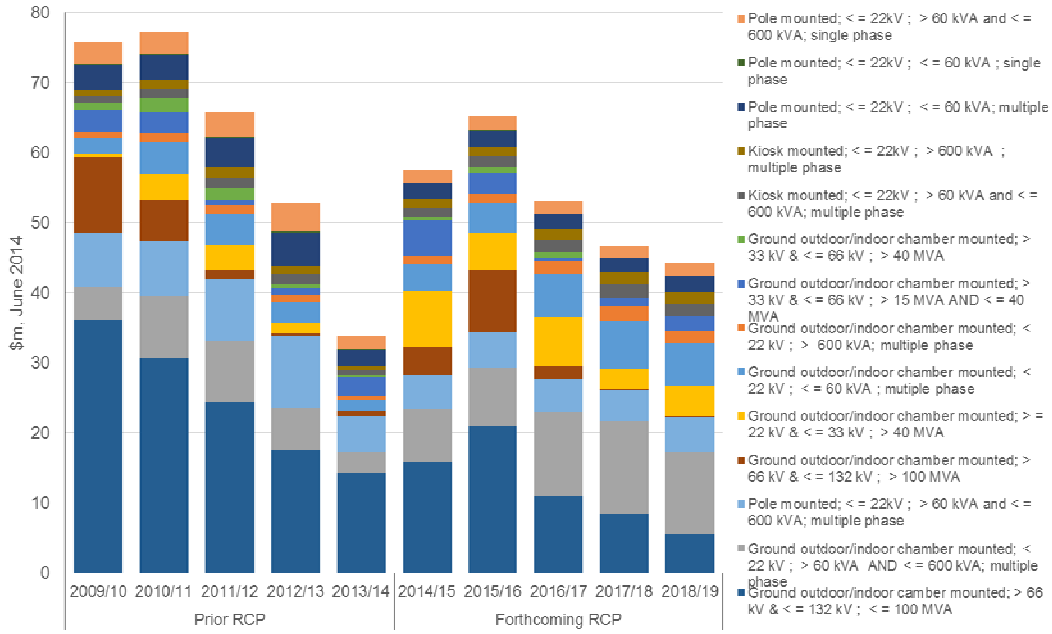
for these substations sets out the strategies adopted for the range of substations.

165. For pole-top substations, Ausgrid forecasts completing replacement of its two-pole substations and undertaking over $50m of pole substation replacement, primarily due to the condition of the supporting pole (on the basis that it is more cost effective to replace both assets).

Expenditure trends

166. Repex for transformers provided in the RIN is depicted below.

Figure 10: Ausgrid transformer repex compared with historical spend



Source: Ausgrid RIN data

167. As shown in Figure 10 above, Ausgrid's transformer expenditure has been focussed on 66kV and 132kV replacements and is forecast to move to addressing corrective failure of 22kV transformers. We asked Ausgrid to explain the reason for the low expenditure in 2013/14 and were advised at the onsite meeting that the data provided was only for part of the year.

Alignment of expenditure and strategy

168. The reducing overall expenditure on transformers over the 2015-19 RCP suggests that Ausgrid's condition-based life-cycle management approach is achieving lower costs.

169. Whilst we have reservations about Ausgrid's risk analysis, which results in most risks being rated extreme, we note that Ausgrid's actual expenditure forecast is derived from a reasonable replacement/refurbishment options analysis. Ausgrid uses the transformer repair/replace investment decision (TRRID) model to support its replacement/refurbishment decisions. Whilst we have not reviewed the model in detail, the description of the model and its outputs seems reasonable.

170. Given the maturity of asset condition data and the strategic assessment that Ausgrid has applied to substation assets, we consider that the strategies have a sound basis for their selection and are appropriate for the asset classes.

5.2.5 SCADA, network control and protection

Ausgrid's strategy for SCADA, network control and protection

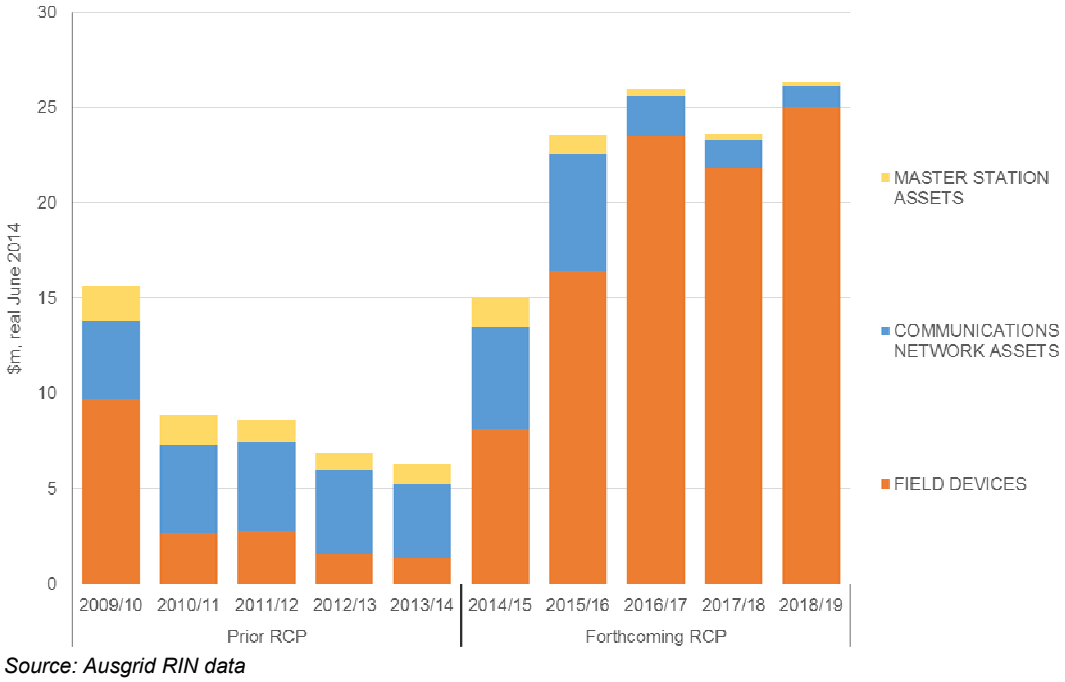
171. In ACAPS2009 Secondary Protection & Control Systems, Ausgrid considers two options: do nothing and planned replacement. It has implemented a planned replacement regime, the justification for which is limited by poor historical failure data. Failure predictions have been extrapolated from only three years' worth of failure data, leading to a slower start to the replacement program to allow further assessment of the condition of the protection relay fleet.

172. In ACAPS2003 Protection and Control Systems (Reactive), Ausgrid acknowledges the paucity of asset failure history and costs. Its strategy is to make provision for asset replacement based on failure projections derived from ad hoc failure records and to improve its asset data progressively.

Expenditure trends

173. The proposed repex allowance for SCADA, network control and protection provided is depicted in Figure 11 below.

Figure 11: SCADA, network control & protection repex versus historical spend



Source: Ausgrid RIN data

174. The step change in expenditure in this category can be seen as being attributable to Field Devices. During on-site discussions it was stated that the step change may in part be due to classification issues between RCPs. Nevertheless, absent any correction or reconciliation from Ausgrid, our assessment is necessarily made based on the audited information that Ausgrid provided to the AER.

Alignment of expenditure and strategy

175. ACAPS2003 states that, "the asset base for this ACAPS has not been historically recorded in any corporate database and as a result it is not possible to present detailed failure history and financial costs for these assets. Secondary protection relay devices have recently been added (2012) to Ausgrid's corporate database (SAP). The historical expenditure shows the need for better asset recording for these assets. With the recent creation (2012) of these assets in SAP, the historical data required to provide clarity for replacement program will be available."[48]

176. ACAPS2003 also informs us that the projected expenditure for the 2015−19 regulatory period has taken into account "*anecdotal evidence and the limited failure data that has been captured in SAP"*.

177. It is therefore difficult to draw any comparisons between historical and forecast expenditure for this asset category. For the reactive component of the forecast expenditure, ACAPS 2003 and 2009 inform that:

- *"The expenditure in the first three years of this current regulatory period show a significant expenditure on reactive replacement. These actual costs, in conjunction with anecdotal evidence and limited failure history, have been reviewed to establish the reactive dollars for the 2015−19 regulatory period. This has included analysis of manufacturer, model type and population count to identify the reactive replacement count for the sub-programs. All of the newly identified sub-programs for these assets cover reactive replacement."*
- Development of the planned replacement program is the *"culmination of a number of factors that include: particular types of asset failures, increased failure rates, increasing maintenance costs and the outcomes of maintenance requirements analysis. For each of the programs the quantities have been set based on the risk of failure and the types of asset replaced, as well as the resources available to deliver the program."*[49]

178. The average age and the age of assets above the standard life reported in ACAPS2009 do not support the rapidly increasing expenditure. As discussed, there is inadequate condition based justification.

179. The risk assessment reported in ACAPS2009 is based on Ausgrid's operational risk matrix and identifies two extreme risks from the relay failing to operate. If the NNSW matrix was used, these would be rated as high risks. The application of the risk criteria to the loss of supply probability and consequence is conservative. However, Ausgrid is right to identify malfunctioning distance and (to a lesser extent) VR relays as important components of network safety and reliability. There is no structured risk assessment in ACAPS2003.

180. ACAPS2009 only considers one option (in addition to doing nothing), which is planned replacement (i.e. prior to breakdown failure). Whilst the planned

[48] ACAPS2003 Section 4

[49] ACAPS2009 Section 8.1

replacement option is shown to be superior to the reactive replacement (the do nothing option), the lack of analysis of credible alternatives, such as reduced or increased expenditure over time, casts doubts over the prudency of the program. There is no option analysis in ACAPS2003.

181. Neither ACAPS2003 nor 2009 provide sufficient evidence that the costs incurred, or forecast to be incurred, in undertaking the proposed volumes of secondary equipment replacement are efficient.

182. Neither ACAPS2009 nor 2003 contain sufficient information to instil confidence that Ausgrid can deliver a rapid escalation in the forecast volume of secondary equipment work at an efficient cost.

183. Given the issues with reliable historical data on which to base the substantial proposed step change expenditure in this asset category, we consider that the forecast has a material speculative component. The ACAPS documents do not present an appropriate level of analysis and justification to support a $100m plus expenditure program. Accordingly, we are not convinced that such a step change in expenditure from historical levels is adequately justified.

Appendix A Scope of Review

The business forecast is reasonable and unbiased

- Are the forecasting practices and assumptions reasonable and unbiased?
- Note: this applies to all relevant types of forecasts, e.g. expenditures, volumes, resources, performance trends. Among other matters, consideration of practices and assumptions should extend to the standards applied (implicitly or explicitly) over the forecast period.
- Do the differences between historical forecasts and corresponding actual expenditures demonstrate unbiased forecasts?
- Can any variations between historical forecasts and actual expenditure be reasonably explained in terms of prudent and efficient responses to changes in the business circumstances?
- Are the resources estimates and unit rates employed in the business' expenditure forecasts reasonable and unbiased estimates?
- Do estimates include additional works or deliverables that are not related to the identified need(s) for the work?
- Does the business' overall capex works portfolio reflect an efficient allocation of resources over time and ensure delivery of the planned works?

The business' costs and work practices are prudent and efficient

- Do benchmarks demonstrate that the forecast costs are commensurate with industry levels of efficiency after accounting for the reasonable impact of exogenous factors?
- Do the trends in performance outcomes reasonably indicate that the required or efficient service levels are unlikely to be maintained unless additional or modified actions (and hence costs) are taken to intervene?
- Are works reasonably strategically aligned to efficiently allocate resources to the maintenance and development of the network over time?
- Are work practices effective and efficient at achieving the required outcomes with the minimum resources reasonably required?
- In terms of FTE numbers, deployment, insourced versus outsourced resources, do these arrangements reasonably the minimum costs necessary to undertake the work volumes required to achieve the capex objectives and maintain the required or efficient service levels?

The business' risk management is prudent and efficient

- Is the business' (implicit or explicit) identification, characterisation and evaluation of risk a reasonable and unbiased estimate?
- Note: consideration should extend to the nature and character of the hazard, its extent, timing, frequency or realisation, and consequence of realisation including the impact on performance targets and/or performance trends on the required or efficient service levels.
- Is the selection of risk treatment (accept, manage, mitigate, avoid) unbiased and reasonably optimal in terms of customer costs and benefits as well as who can reasonable manage the risk?
- Note: consideration of this aspect should extend to the whether the selection of options (e.g. operational, demand management, risk management, capital based) demonstrates bias in risk management practices (e.g. build the risk out (avoid) rather than manage operationally). Consideration should also include whether the business already treats the risk through other current or planned risk treatments and the implication of this in terms of the significance of the risk and the customer costs and benefits.
- Is investment timing unbiased and reasonably optimal in terms of risk adjusted customer costs and benefits?
- Excluding required (mandated) changes, are any changes in the levels of risk (implicitly or explicitly) commensurate with changes in customer costs or benefits?
- Are work volumes and resources allocated to maintain performance at the required or efficient service levels commensurate with the risk adjusted customer costs and benefits?
- Note: consideration should include how work volumes and allocation of resources reflects targeted management of root causes of that drive performance trends commensurate with the risk adjusted customer costs and benefits.
- Do the relevant applicable standards (i.e. planning, design, asset management, operational standards) applied by the business (implicitly or explicitly) reasonably allocate risk commensurate with the customer costs and benefits?
- Are any risk allowances unbiased estimates of total portfolio level risks?

Appendix B Projects reviewed

184. In deriving our summary assessment of Ausgrid's expenditure programs (presented in Section 5), EMCa reviewed a number of documents presented by Ausgrid as part of its 2014-19 Revenue Proposal submission to the AER.

185. The documents were specific to either repex 'programs' (pertaining to asset categories, typically covering high volumes of asset replacement over many years, and found in ACAPS) or 'projects' (pertaining to unique parcels of work, often as part of Area Plans, and found in Strategic Asset Prioritisation Documents).

186. We also reviewed reports by Ausgrid-appointed consultants to examine various aspects of its repex proposal.

Table 5: Projects/programs and related reports reviewed

Asset Category	Doc Reference	Document Title
Area Plans	Area Plan 26	Inner Metro - Transmission
	SAP[50]	11kV switchgear
	SAP	Subtransmission cables
	ID00076	Methodology & Cost Estimates for Costing specific 33kV & 132kV UG feeder projects
	ID00212	SKM Review of Subtransmission Cable Replacement Strategy
Replacement	ACAPS7007	Transformer Repl & Spares Programs
	ACAPS7006	System Spares – Zone & STS Subs
	ACAPS6022	Low mains
	ACAPS6021	Water Crossings
	ACAPS4032	LV UG Cable Reactive Repl km
	ACAPS4030	Low voltage UG CONSAC Cable
	ACAPS4004	O-H Mains Reactive Conductor Replacement km
	ACAPS4002	Steel Mains and ACSR
	ACAPS4001	Poles
	ACAPS2012	HV & LV Switchgear
	ACAPS1002	Chamber & Outdoor Enclosure Substations
	ACAPS1001	Pole Mounted Substations
	ID00129	Spares Strategy – ASM-STG-10004
	ID07366	Replacement & DOC Plan (distribution projects) unit cost methodology
Duty of Care	ACAPS6002	Noisy Transformers

[50] Strategic Asset Prioritisation